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ABSTRACT

Because many textbooks contain sparse headings or no headings at all, the effectiveness of having students generate their own headings while studying material from an introductory biology text was investigated. General psychology students (N=51) were randomly assigned to three groups: (1) Headings Generation, given instructions on creating a hierarchical set of headings to facilitate recall of a passage; (2) Headings Given, studied passage containing embedded headings with no instructions on headings usage; and (3) Control, received passage with no headings or instructions. Four measures (essay, outline, multiple-choice, short answer) were used to assess performance on an ecosystems passage. Results supported the expectation that the Headings Generation group would score significantly higher than the other two groups. However, the second expectation that the Headings Group would score better than the Control group was not supported. It is suggested that the mere presence of headings in text is not necessarily sufficient to substantially facilitate processing of academic text. Instead, it appears that the learner's attention must be directed toward the processing aids, supporting the notion that having students generate their own text headings is an effective strategy for both directing students' attention to the salient topics within a passage and encouraging students to actively process the text material. (Author/JN)

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Effects of Individual Differences, Processing Instructions, and Outline and Heading Characteristics on Learning from Introductory Science Text

Section 3: Generation of Descriptive Text Headings

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FINAL REPORT

January 1982

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TABLE OF CONTENTS

Section 1: Utilizing Intact and Embedded Headings as Processing Aids with Non-Narrative Text

Section 2: The Effects of Author-Provided Headings on Text Processing

Section 3: Generation of Descriptive Text Headings

Section 4: The Effects of Schema Training and Text Organization on Descriptive Prose Processing

General Summary

A series of experiments were conducted to examine the impact of author-provided and student-generated headings on the recall of 2,500-word excerpts from basic science textbooks. If the students are sensitized to the presence of author-provided embedded headings, the delayed recall is significantly enhanced in comparison to individuals studying text without headings. However, author-provided intact headings (i.e., outlines) did not lead to significant improvements in recall.

Instructing students on using embedded headings to aid in the comprehension, storage, and retrieval of the text information led to even further improvements in delayed recall performance in comparison to groups receiving either no headings or no instructions on using headings. However, limiting instructions to only the inputting or outputting of the text material did not prove to be effective.

Since many texts contain only sparse headings or no headings at all, the impact of students generating their own headings was assessed. This generation activity led to improvements in delayed recall in comparison to either author-provided headings or no headings.

Intermediate between having the students generate their own headings and directly employing author-provided headings is an approach which provides the students with a generalized set of headings (knowledge schema) that can be imposed on a variety of texts. A knowledge schema for scientific theories was created and students were trained in its use as a text processing technique. Two studies indicated that this training led to improved recall

in comparison to students using their normal study methods. In addition text organized according to this schema was recalled better than text organized in a coherent, alternate presentation sequence.

In conclusion, the results of the reported series of experiments suggest that under most conditions author-provided, embedded headings facilitate descriptive text processing. Further, having students generate their own headings or having them impose a general set of categories (knowledge schema) on a body of text appears to result in even more effective text recall. The pragmatic and theoretical implications of these findings are discussed within each section of the report.

This final report consists of descriptions of a series of experiments conducted to examine the role of topic headings (author-provided and student-generated) in text processing. These experiments fulfill the requirements set forth in NIE Grant Number NIE-G-79-0157.

Generation of Descriptive Text Headings

Abstract

This study assessed the effectiveness of having students generate their own headings for scientific text. Results revealed that generating headings enhanced performance on a number of recall measures compared to either author-provided headings or no headings. Educational implications are discussed.

Generation of Descriptive Text Headings

The present study is a continuation of a research program designed to investigate the utility of headings as facilitators of scientific text processing. Prior studies within this program have shown that author-provided embedded headings lead to improved performance on selected text processing tasks (Holley, Dansereau, Evans, Collins, Brooks, & Larson, in press; Dansereau, Brooks, Spurlin, & Holley, Note 1) and that training students to use author-provided headings during studying and recall leads to even further facilitation on some tasks (Brooks, Dansereau, Spurlin, & Holley, Note 2). Unfortunately, many textbooks contain only sparse headings or no headings at all. It is therefore important to determine the effectiveness of having students generate their own headings while studying text material.

There has been very little prior direct research on student-generated headings. Doctorow, Wittrock, and Marks (1978), using narrative prose found that instructing students to write one-sentence elaborations of headings, or generate their own headings, enhanced learning of the prose material. Similarly, Dee-Lucas and DiVesta (1980), testing four types of processing aids, showed that providing students with headings or having them create their own headings significantly improved text performance. However, no significant difference was found between students provided with headings and students who generated their own headings.

There are a number of problems with these two studies that inhibit the generality of these findings to typical applied settings.

1. Both studies used relatively short prose passages (< 600 words), consequently, the generality of these findings to larger bodies of material remains in question.

2. The prose used in these studies was either narrative or artificially generated descriptive material. Will the findings hold with naturally occurring, descriptive passages?

3. Because the passages used in these studies were short, the students were not instructed to focus on the interrelationships (i.e., the hierarchical nature) of the headings they generated. The generation of a hierarchically related set of headings may lead to greater facilitation of prose processing than the generation of independent headings.

The present study was designed to correct these problems and thereby extend the research on student-generated headings to a more applied domain.

Method

Participants

Fifty-one students were recruited from general psychology classes and randomly assigned to the following three groups: (a) Headings Generation (n=19) -- This group was given instructions on creating a hierarchical set of headings to facilitate recall of a passage; (b) Headings Given (n=16) -- This group studied a passage containing embedded headings, but did not receive special

instructions on headings usage; (c) Control (n=16) -- This group studied a passage that did not contain headings.

Stimulus Material

A 2,500-word prose passage on ecosystems was used to assess performance in this study. This passage was selected from an introductory college textbook and has been utilized in a number of previous experiments (e.g., Dansereau, Holley, Collins, Brooks, McDonald, Larson, 1980; Holley et al., in press).

For the Headings Given group, passage headings were created by having five judges familiar with the passage rate the author-provided headings on a nine-point Likert-type scale (1=very inappropriate, 9=very appropriate), and provide alternatives for those headings receiving a rating less than 7. This procedure was repeated until all proposed headings received a rating higher than 7 from each judge. In addition to this criterion, all headings were restricted to providing information to the reader that was also available in the section of the text following the headings.

Measures

The Delta Vocabulary Test (Deignan, 1973), which was used as a covariate, was included as a measure of verbal aptitude. This scale has been shown to be moderately related (.60) to other more time-consuming measures of verbal aptitude (e.g., Scholastic Aptitude Test).

Four dependent measures were used to assess performance on the ecosystems passage. These measures have been used in previous

experiments (e.g., Dansereau, et al., 1980; Holley et al., in press), and have been shown to be sensitive to treatment effects under similar conditions. The measures were: (a) Essay -- Participants were given 17 minutes to write an organized summary of the passage, (b) Outline -- Participants were given a sample outline format and were asked to create an organized outline of the passage (10 minutes), (c) Multiple Choice -- 28-item test (10 minutes), and (d) Short-Answer -- 9-item test (12 minutes). The multiple choice test has been used previously (Dansereau et al., 1980), and has been modified on the basis of item analyses.

Procedure

All participants were given three experimental sessions. In Session 1 the participants filled out consent forms and were administered the Delta Vocabulary test. The Headings Generation group received a two-page set of instructions on creating and using headings during studying. These instructions contained a rationale for the importance of headings, a description of the characteristics of "good" headings (emphasizing the relationship between headings and the hierarchical structure of text), and guidelines for developing and using a set of headings with unfamiliar text. More specifically, students in this group were asked to create headings with a hierarchical structure that indicated the main points for subsections of material within the passage. In this first session, the Headings Generation group practiced these techniques on a 1,200-word passage that described functions of the nervous system. The Headings Given and Control

groups also studied the ecosystem passage for 55 minutes.

During Session 3, which occurred 5 days after the second session, the four dependent measures were administered in the following order: essay, outline, short-answer, and multiple choice. Battig (1979) has suggested this pattern of recall-then-recognition test administration.

Results

All dependent measures were scored according to pre-determined keys without knowledge of group affiliation. Interrater reliability for essay content and essay organization was assessed by having a second person score a random subset of the exams. A Pearson product-moment correlation was computed and a correlation coefficient of .84 was obtained for essay content, and .93 for essay organization.

A multivariate analysis of covariance was conducted with the Delta Vocabulary scores as the single covariate and the essay (content and organization), outline (content and organization), short-answer, and multiple choice measures as the six dependent variables. A Wilk's Λ of .595 was obtained with a corresponding $\underline{X}^2$ value of 21.52 with 12 degrees of freedom. The $\underline{X}^2$ value was significant at the .04 level indicating that there was an overall significant difference between the groups using a weighted combination of the dependent variables.

As suggested by Cramer and Bock (1966) and Hummel and Sligo (1971) follow-up univariate analyses of covariance were run on each separate dependent variable. Again the Delta Vocabulary scores were used as a covariate. The parallelism of the within-cell regression slopes was tested for each analysis, and in all cases the regression slopes were found to be homogeneous.

The ANCOVAs indicated significant mean differences between groups on essay content, $F(2,47) = 7.73$, $p < .001$; outline content $F(2,47) = 3.22$, $p < .048$); essay organization, $F(2,47) = 4.52$, $p < .016$; and short-answer, $F(2,47) = 3.82$, $p < .028$. Outline organization and multiple choice comparisons were nonsignificant.

Tukey post-hoc comparisons were computed for all significant univariate ANCOVA results. These analyses revealed that the Headings Generation group had significantly higher scores than either the Headings Given ($p < .01$) or the Control ($p < .01$) groups on the essay content measure. The Headings Generation group significantly outperformed the Control group ($p < .05$) on the outline content measure. The Headings Generation group was also significantly different from the Headings Given group ($p < .05$) on essay organization. No other post-hoc comparisons were significant. Examination of Table 1 indicates that the mean performance of the Headings Given group was greater than the Control group on all dependent measures except essay organization, although the differences were not statistically significant.

Insert Table 1 about here

Discussion

This study investigated the effects of student-generated and author-provided headings as processing aids for scientific text. It was expected that since generated headings encourage the learner to actively use his/her own knowledge in comprehending prose material, in addition to the other possible benefits of headings, that the Headings Generation group would outperform both the Headings Given and Control groups. Also, it was expected that the Headings Given group would perform better than the Control group.

In general, the results support the first expectation in that the Headings Generation group scored significantly higher on a subset of the dependent measures than either the Headings Given or Control groups. In addition, as can be seen in Table 1, the Headings Generation group scored consistently higher on all of the dependent measures than the other two groups. This finding, which extends the prior research of Doctorow et al. (1978) and Dee-Lucas and DiVesta (1980), strongly suggests that students should be instructed to create their own headings in studying text with sparse, inappropriate, or no headings.

The second expectation was not supported in that the Headings Given group did not significantly outperform the Control group on any of the dependent measures. However, the mean performance of the Headings Given group was higher on all but one (essay organization) of the dependent measures as shown in Table 1.

This lack of a significant difference between the Headings Given and Control groups is at variance with the Dansereau et al. (Note 1) study in which a significant difference was reported. One explanation as pointed out by Brooks et al. (Note 2) is that the lack of a significant difference between these two groups may be due in part to the sensitization of the students to the presence of headings. In the Dansereau et al. (Note 1) study, students were given both immediate and delayed passages and tests (which included an outline/headings exam), and a questionnaire concerning the participants' typical use of outlines and headings. In the present study, as well as the Brooks et al. (Note 2) study, students were not exposed to either of these variables. It is therefore possible that students in these two studies may not have directed a sufficient amount of attention to the headings in order to effectively use them as processing aids.

On the basis of these findings it appears that the mere presence of headings in text is not necessarily sufficient to substantially facilitate processing of academic text. Instead, it seems probable that the learner's attention must be directed towards the processing aids. In particular, the present results support the notion that having students generate their own text headings is an effective strategy for both directing students' attention to the salient topics within a passage, and encouraging students to actively process the text material. Additionally, given the effectiveness and simplicity of teaching students to generate their own headings it is expected that the obtained effects should be fairly stable over time. Having students generate

their own headings should, therefore, be given strong consideration as a viable technique for increasing the effectiveness of text processing.

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Table 1

Adjusted Means and Standard Deviations for Each of the Dependent Measures*

GROUP		ESSAY		OUTLINE		MULTIPLE CHOICE	SHORT ANSWER
		Content	Organization	Content	Organization		
Headings Generation (n=19)	$\bar{x}$	14.07	4.45	17.08	2.50	18.62	17.17
	sd	3.34	1.75	5.89	1.71	2.26	5.18
Headings Given (n=16)	$\bar{x}$	9.65	2.84	14.52	2.04	17.26	12.87
	sd	3.77	1.12	6.91	1.37	3.90	5.99
Control (No Headings) (n=16)	$\bar{x}$	9.57	3.44	11.64	1.43	16.51	12.42
	sd	4.42	1.68	5.73	0.98	3.76	5.52

*Scores adjusted using Delta Vocabulary measure as covariate.